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Subj: PREVENTING HEAT CASUALTIES

1. **PURPOSE.** This publication provides information and guidelines to help prevent heat casualties for personnel exposed to heat stress environments.
2. **ACTION.** Area and district commanders, commanders of maintenance and logistics commands, commanding officers of headquarters units, and Commander, Coast Guard Activities Europe shall ensure dissemination of the contents of this publication.
3. **SCOPE.** This publication contains general heat stress information applicable to all Coast Guard members. For those personnel assigned to cutters, Cutter Heat Stress Program (CG), COMDTINST M6260.17 (Series), provides policy and additional information regarding the control of heat stress.
4. **BACKGROUND.** Personnel are apt to suffer heat disorders during exposures to warm climates, while working in hot environments, or during strenuous physical activity in cool as well as hot environments. Heat disorders may result in time lost from duty, serious injury, or death. Many of these disorders also result in prolonged or permanent impairment of the affected person's ability to withstand heat, so initial prevention is particularly important.

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(cont'd) Personnel that are unacclimatized, overweight, or in poor physical condition are particularly susceptible to heat stroke and other heat disorders. Therefore, all personnel should be aware that good physical condition and acclimatization are expected of individuals in heat stress environments.



MICHAEL HUDGINS

Chief, Office of Health and Safety

Encl: (1) Essential Information Regarding Preventing Heat Casualties  
(2) Wet Bulb Globe Temperature and Water Recommendations

ESSENTIAL INFORMATION REGARDING PREVENTING HEAT CASUALTIES

1. Body Heat and Environment. An individual's core temperature is a function of both personal factors (activity, clothing, acclimatization, hydration, etc.) and environmental conditions (temperature, humidity, air movement, radiant heat, etc.). Significant change in any one of these factors or small changes in many of them can combine in their effect to produce varying degrees of heat strain. Careful attention to these heat stress factors including physical demands on personnel, fitness, required clothing, state of hydration as well as environmental conditions is essential to prevent heat casualties.
2. Nature of Heat Disorders and Illnesses.
  - a. Heat disorders have a worldwide distribution and may even occur in cool climates if metabolic heat production exceeds an individual's adaptive abilities. In severe cases, heat disorders may be accompanied by changes in body electrolytes (salts and minerals needed by the body for normal functioning, e.g., calcium, potassium, sodium chloride, etc.) and fluids. Acute overheating may lead to numerous heat-related illnesses. For practical purposes, there are four categories of heat illnesses: heat rash, heat cramps, heat exhaustion, and heatstroke.
  - b. Heat rash (prickly heat) is common among military populations living in hot climates or working in hot spaces ashore or aboard ships. It interferes with sleep, impairs sweating, and decreases evaporative cooling, predisposing the individual to more serious heat disorders and hastens the onset of heat stroke.
  - c. Heat cramps (muscle cramps) may occur either alone or with heat exhaustion. Heat cramps may be localized or generalized with involvement of recently stressed muscle, particularly those of the extremities and abdomen.
  - d. Heat exhaustion is far more complex than heat cramps. Heat exhaustion is characterized by an inability of the body to give off enough heat due to overloaded but functioning body cooling mechanisms. When prompt first aid is administered, the death rate from heat exhaustion is extremely low; however, a medical evaluation with follow-up is needed in all cases. Signs of heat exhaustion are pale, clammy skin; profuse sweating; weak, rapid pulse; headache and nausea; and dizziness. The body temperature remains normal or may fall slightly.

- a. Heatstroke is the most serious of all heat disorders and is an immediate threat to life. ALL INCIDENTS OF HEATSTROKE ARE MEDICAL EMERGENCIES. There is a high death rate associated with heatstroke. Whereas heat exhaustion results from overloaded heat balance mechanisms that are still functioning, heatstroke occurs when these mechanisms cease to function. Due to the extreme seriousness of heatstroke, all personnel should be taught the importance of recognizing the early signs of this disorder and the need for prompt, effective treatment at a reversible stage. Signs of heatstroke are high body temperature; skin which becomes hot, dry, and red; breathing which is deep and rapid; and pulse which is strong and fast. There may be preliminary symptoms, such as headache and nausea, but often the first signs are collapse and loss of consciousness.

3. Susceptibility of Personnel.

a. Physical Activity.

- (1) Personnel who do not do regular aerobic exercise or are unaccustomed to physical work in high temperature or humidity environments are particularly at risk for heat injury. Excess body weight contributes to this susceptibility.
- (2) A period of 2 weeks (or more) of gradually progressive exercise or training is necessary for adequate conditioning and acclimatization under most field situations. However, even well-acclimatized personnel cannot perform normally in some high temperature/humidity spaces and other sites of extreme environmental conditions.

- b. Fluid and Electrolyte Balance. Conditions that alter the body's fluid and electrolyte balance increase an individual's susceptibility to heat illnesses (such as lack of fluid intake, kidney disease, high blood pressure and its medication, "stomach flu", sea sickness, etc.).
- c. Clothing. Water impermeable clothing greatly increases an individual's susceptibility to heat exhaustion or heat stroke. The clothing acts as a barrier that prevents evaporative cooling. Many synthetic fabrics reduce the absorption and dispersal of sweat needed to achieve optimum heat loss by evaporation.
- d. Fatigue. Cumulative fatigue may develop slowly and must be recognized as a significant factor increasing one's susceptibility to heat exhaustion or heat stroke.
- e. Prior Heat Illness. Prior heat illnesses have been shown to increase susceptibility to subsequent heat illnesses of greater severity with each incident.

- f. Other factors which may cause problems include alcoholism, sunburn, fever, and some medications, such as aspirin, and certain sea sickness, nausea, cold, and hypertension medications.

4. Environmental Heat Measurement.

- a. All personnel (and their supervisors) who are exposed to high environmental temperatures for extended periods of time should be familiar with the Wet Bulb Globe Temperature (WBGT). Standards for activity levels and water requirements are based on this method of determining temperature.
- b. For vessels, the procedures and equipment prescribed in COMDTINST M6260.17(series), Cutter Heat Stress Program (CG) apply for identifying, measuring, and controlling heat stress.
- c. The WBGT is based upon a simple combination of three different temperatures: the wet bulb temperature; the black globe temperature; and shaded dry bulb temperature. The exact formula for calculating the WBGT is contained in enclosure (2). These various ways of taking temperatures take into account radiant heat, humidity, air temperature, and air movement. These three different devices are usually combined into one instrument that can give either the separate temperatures or the combined, calculated WBGT.
- c. While commands are not required to have the capability to continuously measure the WBGT, they should have them determined for any operational or training condition that might exceed safe limits (see enclosure (2)). If a command does not want to purchase an instrument capable of measuring the WBGT, it can arrange for the measurements to be done through the appropriate Maintenance and Logistics Command (kse).

5. Preventive Measures. The following measures are helpful in preventing heat illness. The use of any or all of them may be necessary, depending upon the overall situation during periods of heat stress.

a. Water.

- (1) Water is required in sufficient amounts to prevent dehydration resulting from losses in sweat, urine, etc. The belief that individuals can be trained or conditioned to a decreased water intake is incorrect and dangerous.

- (1) (cont'd) Under conditions of profuse sweating, each person requires one pint (0.5 liters) or more of water intake per hour. The water should be taken in small quantities at frequent intervals, such as every 20 or 30 minutes. The optimum temperature for drinking water is 50 - 70°F (10.0 - 21.1°C).
- (2) Up to a point, humans can function with an inadequate water supply, but at an increasing cost. They can continue, but not without a progressive deterioration of performance until irreversible damage is done. See enclosure (2) for additional information on water requirements.

b. Clothing.

- (1) Clothing and equipment should be worn in a manner which permits free circulation of air between the uniform and the body surface. Wearing shirt collars, shirt cuffs, and trouser bottoms open will help in ventilation. However, this practice may not be permissible where loose fitting or style clothing present a safety hazard (e.g., around machinery with moving parts, industrial areas, etc.).
- (2) In the presence of full sunlight or a high radiant heat source in machinery spaces, keeping the body covered with permeable clothing (clothing made of a material which allows air and moisture to pass through) helps reduce the radiant heat load upon the body. When heat exposures do not include much radiant heat, removal of outer clothing helps reduce body temperature.
- (3) Heat illnesses may be manifested in minutes if impermeable clothing (clothing which does not allow air and moisture to pass through) is worn. Therefore, impermeable clothing must be avoided, unless required for protection from toxic agents. If impermeable clothing is needed, precautions must be taken to avoid the rapid buildup of body heat.

c. Salt.

- (1) It took some time to dispel the idea that the body can be conditioned to function efficiently on inadequate water intake ("water discipline" of days gone by). It is now necessary to dispel the idea that massive salt intake is the answer to heat problems. In fact, the opposite is true. Excessive salt consumption must be avoided in attempting to maintain water and salt balance. Too much salt can have serious consequences just as inadequate salt can. The goal is balance, neither too much nor too little.

- (2) The average diet provides from 15 - 20 grams of salt daily. This is more than adequate for acclimatization and maintenance of balance in hot climates. Supplementary salt is indicated only in unusual circumstances as prescribed by medical authority.
- d. Predisposition. There is evidence that one attack of heat stroke or severe heat exhaustion increases the likelihood of a second occurrence of heat illness. This condition is called predisposition. Subsequent episodes are usually more severe than the first. Individuals with a history of heat stroke should not be exposed to conditions that predispose to heat illness.
- e. Acclimatization.
- (1) Training programs for personnel who are climatically and/or physically unseasoned to heat should be limited in intensity and time. A period of approximately two weeks with progressive degrees of heat exposure and physical exertion should be allowed for substantial acclimatization (about 78%). If personnel are required to perform heavy physical work before being properly acclimatized, the work is poorly performed, development of the capacity to work effectively is retarded, and the risk of heat injury and disability is high. A period of acclimatization is necessary regardless of the individual's physical condition, although the better the physical condition the quicker acclimatization is completed.
- (2) Acclimatization to heat begins with the first exposure, and is usually developed to about 45-52% by the end of the first week. Individuals who are unusually susceptible to heat will require additional time for acclimatization. Full acclimatization (the ability to perform a maximum amount of strenuous work in the heat) is attained most quickly by graded, progressively increasing work in the heat. Full heat acclimatization can be achieved by as little as two 50-minute periods of work in the heat each day. The work task should require cardiovascular endurance work, e.g., running in place, rather than muscle work such as push-ups. Resting for three or four days in the heat, with activity limited to that required for existence, results in only partial acclimatization; physical work in the heat must be accomplished for development of full acclimatization to that work level in a given hot environment. A day or two of intervening cool weather will not interfere significantly with acclimatization to a hot climate.

- (3) If it is necessary that work be accomplished during the period of acclimatization, advantage should be taken of the cooler hours in accomplishing the work. A schedule should be established which provides for increasingly longer work periods alternating with rest periods.
  - (4) Adequate water must be provided during the acclimatization period as well as other times.
  - (5) Once acclimatized, personnel will retain most of their adaptation for about one week after leaving the hot environment. However, if not exposed to work at high temperatures, the acclimatization will then decrease at a variable rate, the major portion usually being lost within one month.
  - (6) Under conditions of heat stress, meals should be cool rather than hot. The heaviest meal should be served in the evening rather than at noon. An hour of rest following the noon meal is beneficial.
- f. Work Schedules. Work schedules must be tailored to fit the climate, the physical condition of personnel, and the military situation. Close supervision by medical officers, responsible commanders, and experienced paramedical personnel is essential in achieving maximum work output with minimum hazard. Certain general principles must be considered:
- (1) The amount of heat produced by the body increases directly with increasing work. Therefore, reduction of workload markedly decreases the total heat stress.
  - (2) While decisions to modify work schedules must be governed by the particular local situation, heavy work should be scheduled for the cooler hours of the day such as early morning or late evening.
  - (3) Alternate work and rest periods may prove desirable. Under moderately hot conditions, 5-minute rest periods in the shade alternating with 25 minutes of work in the sun may be desirable. Under severe conditions the duration of rest periods should be increased.
  - (4) Workloads must be reduced at high temperatures when dehydration resulting from excess sweating and lack of water replacement occurs. When water is in short supply, working in the early morning and evenings will allow much more work to be accomplished for the expenditure of a given amount of water than working during the hottest hours of the day.



- (5) Work in the direct sun on hot days should be avoided as much as possible.
  - (6) Unnecessary standing at attention in the heat should be avoided, because prolonged standing places an added burden on the circulation.
  - (7) When the environmental conditions are extreme, physical work should be curtailed or, under extremely severe conditions, even suspended. The temperature at which work should be curtailed or suspended depends on the humidity, radiant heat, air movement, character of the work, degree of acclimatization of personnel, and other factors.
- g. Accession Training. Cadets, officer candidates, and basic trainees comprise a special group of personnel that require particular attention because of the unusual physical stresses involved in basic training, especially in summer heat. Adjustment to this stress is difficult and must be taken into account in planning daily routines. Curtailment of strenuous outdoor work and stressful physical activity will yield greater efficiency and less disruption of training than will insistence upon routine completion of a heavy schedule.
- h. General Health.
- (1) Maintenance of good physical conditioning and avoidance of undue fatigue are important. In becoming acclimatized or in being subjected to high degrees of heat stress, personnel should not become so tired that they retain some fatigue after a normal night's rest.
  - (2) Mild illnesses such as respiratory infections, diarrhea, or reactions to immunizations which do not ordinarily interfere with duty may contribute to susceptibility to heat illnesses. Also, poor physical conditioning, obesity, alcoholic indulgence, lack of sleep, and hypertension or poor cardiovascular responses to exertion correlate with susceptibility to heat illnesses and can serve as warning signs. Special attention should be given to those personnel, possibly by means of a reduced training program and limited heat stress exposures, until their overall physical fitness level has improved.
  - (3) For those individuals who exhibit poor overall physical fitness or in whom an adverse physical condition persists, elimination of heat stress exposures may be necessary.

6. First Aid.

- a. Leaders of small units or groups must be familiar with the symptoms of heat illnesses and must carefully observe their personnel when they are operating under heat stress conditions.
- b. Flushing of the skin is often the first sign noted; and while flushing may not itself signify that heat illness is imminent, people presenting this appearance should be scrutinized for additional symptoms of heat disorder. If dizziness, headache, stumbling or other signs of weakness, undue fatigue, upset stomach, or changes of sweating from profuse to almost none occur, the person should be immediately removed from further exposure and promptly given rest and first aid.
- c. Mild cases will become serious if activity continues in the setting where the illness occurred. First aid measures include: rest; moving to a cool, shady location (if available); loosening clothing; and removing equipment.
- d. If the case appears to be one of heat stroke, the person should be sponged with ice water, if available, otherwise with cold water. Movement of air should be begun by fanning, such as with a shirt. SEEK MEDICAL HELP WHILE THESE PROCEDURES ARE BEING CARRIED OUT.
- e. Individuals suspected of suffering heat exhaustion and who are conscious should sip water, cool if possible, after being moved to a cool, shady location, clothing loosened, and equipment removed.
- f. Individuals suffering from heat exhaustion or heatstroke should be handled as litter cases, or given maximum help aboard ship, if using a litter is impossible. First aid immediately followed by rapid removal of the person to a location that can provide medical care is essential.

WET BULB GLOBE TEMPERATURE AND WATER RECOMMENDATIONS

WORKLOAD AND WBGT ( <sup>o</sup> F): <u>LIGHT</u> <u>MODERATE</u> <u>HEAVY</u>			WORK/REST CYCLE:	WATER RECOMMENDATION:
<86	<80	<77	CONTINUOUS WORK	1 pint of water with each of 3 meals; 1 pint of water prior to exertion; $\frac{1}{2}$ pint of water per hour throughout the day.
87	82	78	WORK 50 MIN/ REST 10 MIN	
89	85	82	WORK 30 MIN/ REST 15 MIN	1 pint of water with each of 3 meals; 1 pint of water prior to exertion; 1 pint of water per hour throughout the day.
90	88	86	WORK 30 MIN/ REST 15 MIN	
>90	>90	>90	SUSPEND ALL TRAINING & EXERCISE	

THE WET BULB GLOBE TEMPERATURE INDEXOUTDOORS:

$$\begin{aligned}
 & 0.7 \times (\text{Wet Bulb Temp}) \\
 + & 0.2 \times (\text{Black Globe Temp}) \\
 + & 0.1 \times (\text{Shaded Dry Bulb Temp}) \\
 = & \text{WBGT (outdoor)}
 \end{aligned}$$

INDOORS:

$$\begin{aligned}
 & 0.7 \times (\text{Wet Bulb Temp}) \\
 + & 0.3 \times (\text{Black Globe Temp}) \\
 = & \text{WBGT (indoor)}
 \end{aligned}$$

**Notes:**

1. WBGT= DRY BULB TEMP WHEN HUMIDITY IS 100%, THERE IS NO BREEZE, AND THERE IS GOOD CLOUD COVER.
2. ADD 10<sup>o</sup> F TO THE WBGT IF WEARING BODY ARMOR OR NBC UNIFORMS

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